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ABSTRACT

Insurance is among the most important tools that have been devised to prepare readiness for dealing with threats. These valuable man-made tools with their capabilities have controlled many undesirable effects of unforeseen events. In each country, growth and development of insurance industry is considered as an indicator for evaluating the level of development. From the perspective of insurers, the risks of energy, especially the oil and gas industry, are known as high risks.
Economic feasibility of the profitability of insurance related to oil and gas wells is the aim of this study that was performed through damage coefficient indicators and profit margin with scenario planning using engineering economics method. The results of this research indicate that the damage coefficient of this field of insurance is much lower than the whole insurance industry and have a suitable and very high profit margin. Therefore, due to the low damage coefficient and high profit margin and the stability of these types of insurance, their profitability is confirmed economically and investment and providing insurance coverage is adequately justifiable for these types of risk.

Keywords: *economic feasibility, profit margin, insurance, oil and gas wells.*

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INTRODUCTION

Currently, Islamic Republic of Iran has the world's highest hydrocarbon reserves. On the other hand, from the viewpoint of the value of petrochemical productions and use of technology in the region, this country is in the second place. The Islamic Republic of Iran is a country that in addition to having rich resources of oil and gas, in terms of geopolitical position is placed between the Caspian region and the Persian Gulfthat doubles its importance. Proximity to the European consumption markets through land in comparison with other countries in the Middle East, as well as access to high seas in comparison with the countries of the Caspian region are considered as the strengths of our country. A stable political and social structure in the region and a higher level of general knowledge and expertise in the country are the advantages of investing in our country that in addition to access to energy, other abundant production factors should also be considered in the country (Abrahami, 2009). The status of crude oil and natural gas in Iran's economy is evident to everyone. The major share of exchange revenues from oil exports in the state budget, the dependency of productive sectors to cheap energy and many other examples represents the position of hydrocarbon fuels in the national economy of a country (Stevens, 2011).
Oil and gas industry is growing day by day and this development and expansion is followed by advances in technology and creating new complexities and challenges especially in activities related to offshore. Today, oil wells are drilled in the oil and gas industry far deeper, harder and more challenging than the past decades.
Although all sectors and processes associated with oil is of great importance, the Drilling sector is in the center and core of this industry because without drillingoperations it would not be possible to reach oil reservoirs. Now, as the drilling depth goes deeper, additional challenges occur on the way of achieving success in drilling. Especially in very deep excavations, the margin pressure is much lower (the difference between the pressure inside the reservoir rock and the required pressure for formation-breakdown[1]) (Fossli, 2004).
Insurance is among the most important tools that have been devised to prepare readiness for dealing with threats. These valuable man-made tools with their capabilities have controlled many undesirable effects of unforeseen events.In each country, the growth and development of the insurance industry is affected by both internal and external factors. Regardless of external factors that have a significant impact on the growth and development of insurance industry, internal factors that are related to the structure and performance of this industry are partly under the control of insurance authorities. If the structure of this industry is designed optimally, it can act in the direction of the development and growth of the country's insurance (Hary, Pitt, 2003).
Generally, the blowout of oil and gas wells is probable in the oil industry and several factors may be involved in this phenomenon. Environmental damages, depletion of reservoir pressure, hydrocarbon mass loss from the reservoir, endangering the lives of staff who work with the drilling machine, damage to equipment and facilities, high costs of controlling the blowout and reduction in the credibility of

[1]The formation-breakdown is the maximum pressure tolerated by the formation. If the hydrostatic pressure is greater than this value, formation breaks down and drilling mud penetrates into the fractures.

drilling contractors can all be noted as the most important results of blowout. The blowout of wells No. 3, 4 and 5 in Dehloran, Nowruz wells, No.50 of Ahvaz, 23 and 29 in Kangan, Kerosene 41, offshore wells of Abuzar platform, Maroon104 and the last one which is the blowout of well No.24 of Naftshahr can be noted as the most important blowouts of oil and gas wells after the victory of Islamic revolution (Bahmani et al. 2011).

The main questions

The main questions of the present research are:

1) What are theoperational risks associated with oil and gas wells?

2) Is the dissemination of policies related to the operational risks of oil and gas wells economically profitable?

This article is organized in three parts to answer the main questions above; the first section is related to detecting and assessing operational risks associated with oil and gas wells. In this regard, 8 basic and operational risks associated with oil and gas wells have been detected and described. The research methodology has been explained in the second part. In this section, feasibility studies of covering these risks have been investigated that damage coefficient indicators and profit margin of oil and energy insurance have been used in them and in the following, the sustainable profitability of these types of insurance and economic feasibility of the dissemination of insurance related to oil and gas wells have been proven by different scenario planning using engineering economics methods.

2. A review of empirical studies

Despite the centuries-old history of the oil and gas industry and the insurance industry in the world and nearly 100-year history of this industry in Iran, few studies have been written about the relationship between these two industries and evaluating the profitability of energy insurance. Also, little research has been done in the field of risks and insurance related to exploration industry and drilling of oil and gas wells. However, given that the aim of this study is to evaluate the profitability of energy insurance, the research results are presented below.

1.2. Internal investigations

Saki Zadeh (2013) by comparing the insurance status of Iran's oil and gas with other countries concludes that risk management in this industry is not updated and is still managed traditionally. In his paper, he tried to deal with the causes of the problem through analyzing the resources and facilities and also difficulties ahead in the oil and gas and insurance industry and lack of their alignment with each other in our country.

Panahi Azad et al (2012) by detecting types of applicable insurance and conditions and characteristics of each of the insurance policies as well as identifying and evaluating companies offering these insurance policies have tried to become familiar with policies and different types of insurance and each of their conditions to appropriately use these insurance in risk management.

Derakhshan (2010) with a brief overview of the nature and extent of the risks involved in different sectors of oil, gas and petrochemicalindustries has dealt with strategies to develop Insurance coverage in the industry and has emphasized on this point that firstly, it is necessary to introduce the existed risks to those who are involved in the insurance industry. Secondly, oil, gas and petrochemical industries in addition to emphasizing on self-insurance, must become more familiar with the financial and technical ability of the domestic insurance industry and have a mutual and constructive cooperation.

2.2 Foreign Studies

Zhaoguang Yuan, et al. (2015) investigated the blowout of oil wells in deep seas. They argue thatdue to the high pressure of such oil wells, equipment and high-pressure pumps must be available for controlling probable blowouts. By dynamic simulations, they show that through optimizing the control operations such as drilling mud density and pump flow rate etc. it is possible to control the blowout of these wells without drilling pressure relief and auxiliary wells.

NoussiaKyriaki (2012) due to recent events and marine accidents and leakage of hydrocarbon materials in the marine environment has expressed the responsibility of each party, the client, contractor, insurance and reinsurance and explained the role of insurance in reducing oil pollution. However, deep-water is the framework of his research. In this research, the risks and insurance related to energy-related pollutions have been expressed by him in detail.

Doukas et al. (2011), while paying attention to the growing energy demand and an increase in Europe's imports, strongly emphasis on the importance of analysis and minimizing the risk in the energy sector. Their objective is to overview potential hazards in Energy sphere and classifying important risks in natural oil and gas section and presentation and analysis of a series of events.

Sharp (2010) examined the insurance related to oil and gas sector. This book explains and discusses the available developments in the oil and gas industry and corresponding coverings to the risks associated with each part. They have paid special attention to the offshore part of oil and gas and have explained the insurance market associated with this sector.

Identifying and explaining the operational risks associated with oil and gas wells, is one of the innovations of this research. Identifying and compiling these risks can assist insurers and insurance industry activists to provide appropriate insurance coverage. Economic feasibility of its profitability and sustainability is also the main innovation of this research that doubles the serious motivation of insurance industry activists for entering the field of energy insurance and particularly oil wells insurance.

3 .The operational risks associated with oil and gas wells

The foundation of activities in insurance industry is based on risk. The uncertainty of causing damage is the definition of risk (Green and Trichman, 1986, p. 24). In other words, risk is uncertainty about financial compensation.

"The uncertainty of deviation of results of an event from the expected values in the future" is one of the valid definitions that have been stated for risk. This definition focuses on the potential damages that are resulted from a future event. These damages can be in the form of expenses or arise from failure in gaining benefits (Derakhshan, 2010).

The existence of large volumes of toxic and flammable materials, using high pressure and temperature, high capital of projects and equipment in oil, gas and petrochemical industries means that risk management is a vital strategy for the survival of these industries (Danaher Corporation, 1994).

Oil disasters are among the biggest socio-economic incidents. A review of a few oil incidents and the extent of their caused damage will show the necessity of paying serious attention to oil and gas insurance and strengthening mutual cooperation

between these two industries more than ever before.For example, Prestige oil spill in 2002 with the cost of $ 12 billion is the world's third major incident. This oil tanker containing 77,000 tons of oil was caught by storm around Spain that as a result, 20 million gallons of oilentered the sea. According to reports, $ 12 billion was the cost of cleaning it up. Also due to a technical mistake in 1988, a massive explosion followed by widespread and unstoppable fire killed 167 people in the oil production platform of Piper Alpha in the North Sea. The total caused damage as a result of this incident is estimated at $ 3.4 billion. Up on now, this disaster is mentioned as the worst accident in the offshore industry both in terms of human casualties and property damage.
Macondo is another oil incident that occurred due to an out of control oil well blowout followed by a huge fire in the Gulf of Mexico in 2010 and subsequently, the oil drilling platform "deep-water horizon" burned in fire. This drilling was carried out at a depth of 5000 meters above the sea floor (sea depth was about 1500 meters). The oil of this well spilled into the sea for 87 days that was about 4 million barrels and led to$ 17 billion damage for the BP Company.

Today, in developed countries due to fatal and irreversible eventsand with the aim of reducing risk and risk management instead of relying on the past limiting rules, oil companies have been forced to devote more resources to safety issues. (Dose ping 2001)

Important and fundamental risks in the drilling industry associated with oil and gas wells have been considered and reviewed in this sector:

3. 1. Blowout risk
Based on historical evidence, the blowout phenomenon was existed from the earliest days of the oil and gas industry and will also continue in the future despite advances in science and technology and educating professionals. In the early twentieth century, no blowout incidents were recorded publicly. However, European and America countries tried to collect information during the past 40 years and conducted countless studies and researches in this field. Presenting blowout reports has been obligatory in America since 1973 that this work has improved the quality of information to study on blowouts (Skalle, 1998).
Blowout is the continuous and uncontrollable penetration of oil and gas flowing out of the oil well; that occurs as a result of the inability to successfully control pressure equipment. The formation pressure must be controlled during the drilling process. To achieve this goal the drilling mud density should be high to prevent the hydrocarbon fluid from exiting the formation. A blowout may be caused by negligence and human error or wellhead equipment failure (Imran, 2013, p. 15).
By examining the recorded blowouts it has been determined that there are more blowouts in exploration wells than development wells. Based on the research of Wylie, 70% of wells drilled in Alberta were development wells. But during the 10 years study, the penetration rate of formation fluids into the exploration wells is 5.7%, while the penetration rate of fluid into the development wells is 3.2%. Therefore, the probability of flood occurrence and the penetration of formation fluid into the exploration well is 2.8 times more than development wells (Wylie, 1990).
Blowout has many different forms that the most important ones of them include: Surface blowout, under surface blowout underground blowout. Surface blowout is more dangerous and also more important than other types of blowout which can lead to huge life, property and the environmental losses (Grace, 2003).

3. 2. The risk of losing the well's control
Well control is known as the process of controlling the discharge rate of hydrocarbon fluid. This process prevents oil blowout according to the tubing design and drilling. These various aspects of drilling are so important that oil companies are prepared to spend billions of dollars to have a safe drilling process
Controlling the blowout of oil and gas wells is divided into three phases (Collins, 2013, pp. 2-3):

A) Primary oil well control
Primary oil well control means controlling via drilling mud. When the formation fluid penetrates into the well, mud weight can be increased with observing the signs of the flood if the fluid velocity is low, so the blowout can be controlled in the beginning of the process.

B) Well killing
If the speed of the formation fluid is high, it will reach thesurface of the earth after a short time. At this stage, a blowout preventer valve which is embedded at the top of the well will be used and a sudden increase in pressure can automatically close this valve to control the blowout.
At this point, the fluid contained at the back of the blowout preventer valve will be removed through volumetric method. To do this, the blowout preventer valve should be opened gradually and in stages to remove the fluid.

C) Oil well harness
If the formation fluid moves upwards with high pressure and speed, and the blowout preventer valve is not yet installed, the pressurized fluid will blow away all the wellhead equipment and throw them all around and the fluid will blowout at the surface and since the ignition temperature of the fluid is low, the fluid is easily ignited and caused a devastating fire.

3. 3. The leakage risk of hydrocarbon materials and water pollution
Marine pollution is one of the risks in which the severity of damage is very high. Presenting a comprehensive definition and preventing marine pollutions is very hard (Patricia Birnie et al, 2009).
Oil spilling in water is usually in two forms of stable and unstable. In the unstable mode, oil tends to quickly scatter in the sea level that this could cause many problems for the clearing operations and water purification. But there is no tendency towards scattering in water levels in the stable mode and are floating at sea level as thick oil spills. The specific gravity of unstable oils is usually less than 0.8 such as gasoline, kerosene and naphtha. Also, the specific gravity of stable oils is more than 0.8 such as fuel oil (Biliardo and Mureddu, 2005):
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) following the incident that occurred for the oil tanker of "Exxon Valdez" on the shores of Alaska, in 1990 was adopted by the International Maritime Organization and was indispensable in 1995. The main emphasis of this convention is on prompt and effective action in the event of oil pollution incident to prevent irreparable damages to ships, offshore installations, ports, loading and unloading equipment and also preparing the grounds for international cooperation to deal with accidents caused by oil pollution.
Before the Macondo oil spill, pollution resulting from oil wells or oil wells blowout did not receive serious attention and most of the insurance companies believed this type of contamination to be almost impossible according to industrial and technology developments. So that it was thought even in case of occurrence, it would be controlled and restrained by

spending very low costs but the Macondo oil spill and leakage of more than 4 million barrels of oil as a result of the blowout and explosion of oil wells in the Gulf of Mexico attracted the attention of insurers and oil contractors to this type of pollution more than before. Also, Macondo oil incident showed that these types of risks are among the risks and so massive accidents.

3. 4. Re-drilling and extra expenses

The risk of re-drilling or extra expenses is one of the other operational risks associated with wells and oil fields. Drilling operations in all the upstream stages including discovery and description and developments in the oil field are among the high and main costs of oil and gas upstream operations particularly drilling operations in offshore and deep-water will make great expenses for the oil contractor. Therefore, it has been tried to conduct the work arrangements and calculations with precision and high sensitivity to achieve the expected results.

Sometimes due to lack of sufficient knowledge about different layers of the earth and fluid properties in each layer and also due to lack of sufficient attention by the person who is in charge for drilling additional costs in order to control and revert the oil well to the original state based on the agreement will be imposed to the drilling contractor. In a general classification, the need for re-drilling operations can be divided into two major reasons:

A) Oil blowout and loss of well control

As mentioned in the previous sections, the probability of flood occurrence and blowout in oil wells is one of the most important risks and hazards of drilling operations. In order to control these blowouts appropriate equipment is embedded in the well that blowout preventer is the most important one of them. In some cases, for various reasons, this blowout preventer and other wellhead equipment cannot prevent the blowout and oil fluid leakage and the blowout occurs and is often accompanied by explosions and fire. In such cases, there is no alternative to control the blowout except relief well drilling and suppression. Usually, the costs of taking back the control of oil well is known as extra expenses that the drilling contractor must do this without asking extra fees from the employer therefore additional costs will be imposed on him.

B) Relief Wells

The purpose of creating these types of wells is to make contact with wells that are about to blowout under the Earth's surface and pump the fluid into the well to complete the well killing operations. The problem is the small size of the objective the diversion well must reach.

Therefore, this requires a careful design and using sensitive GPS devices is critical. Drilling these wells prevents wasting staggering amounts of oil and gas from exploded wells. For example, controlling the Well 23 blowout in Iran's Kangan field can be noted.

3-5- The risk of losing crude oil

The risk of losing crude oil is another risk that may occur during drilling operations or even Crude oil exploitation. This risk is more commonly known as the reservoir risk because in this type of risk, crude oil is lost before it reaches the surface and since this occurs underground, it is known as reservoir risk.

Any reduction of the amount of recoverable oil is known as the loss of hydrocarbon materials whether it caused by God-given losses such as faults and earthquakes, etc., or because of human actions.

In the Gulf of Mexico oil disaster which is also known as the Deep-water Horizon, hydrocarbon materials leaked into the sea for 87 days as a result of surface blowout that a total of about 4.2 million barrels of crude oil was lost. Oil experts announced that the amount of blowout was 50 to 65 thousand barrels per day (BP, 2010). Also, the IXTOC-1oil disaster that has been registered as the biggest accident and oil spill into the sea after the Macondo incident (Deep-water Horizon), about 3.5 million barrels of crude oil spilled into the sea (IXTOC-1, 1979). The amount of oil blowout in the early days before starting the oil well control operations was approximately 30 thousand barrels per day.

3- 6- The risk of loss of drilling mud

Drilling mud or drilling fluid is one of the important discoveries in the drilling industry that has facilitated many drilling works.It can be said that drilling mud has a central role in the excavations. This material, due to its high density, prevents floods and oil blowout from happening and on the other hand guides the drilling logs towards the earth's surface. This material is very expensive. A large amount of loss can double the risk of floods and oil blowout, however, the cost of drilling mud loss is also significant. Drilling mud has a crucial role in the drilling. In fact, human and financial resources depend on this matter and any mistake in choosing the type and weight of the drilling mud can lead to disaster from well closure to melt the mast and death of many people. The path of the mud is like a closed path that starts besides the mast and passes through the tubes and then come out of the gaps in the drill and after that, returns to its initial position through the sides of the drilling pipe. The drilling mud has a crucial role in this path.

Drilling mud that is used to drill oil and gas wells can be divided into three categories: water based drilling mud, oil-based drilling mudand Gas-based drilling mud. Other materials and elements can be used to modulate the density and viscosity of drilling mud.Bentonite and Barite are two common elements to increase the density of drilling mud (SPE 14955, 2012).

3. 7. The risk of removal of wreckage and debris

This type of risk is mostly related to offshore drilling operations. Of course, it doesn't mean that this risk does not exist in onshore drilling operations but since the costs of onshore debris clean-up operation is much lower than drilling expenses, for this reason, it is often overlooked.

Until now, no comprehensive definition has been provided for "Wreck". Also, this word has not been defined, not even in the energy policies. However, to avoid the debate about the nature of thewreck and also, duo to the inclusion of this term to broad and fine concepts in offshore oil and gas industry, usually another name which is "debris" is added to the word "wreck" in order to include any object, wreck or debris that is thrown to the sea as a result of human activities.

Usually, the risk of removing the wreck and debris, like some other risks, is in the event of an accident. In the offshore drilling operations, when blowout occurs and the drilling well is out of control it is usually accompanied by fire and needs to

be controlled quickly otherwise it cause the oil rig and the drilling platform to sink in to the deep seas. According to international and environmental conventions, these debris and sunken wrecks should be pulled out as soon as possible.

3-8 - The risk of equipment and devises

Another significant risk in the oil and gas drilling industry is the risk of loss and downtime of drilling devises and equipmentwhen various events like blowout and fire in oil and gas wells happen. Devices and equipment used in the drilling industry are less costly than those that are used in the field of production and development especially when drilling is in the land. More advanced and more costly equipment and devices are usually used in offshore drilling

Equipment and devices associated with the drilling industry can be divided into six parts:

a) The rotational system; b) Hoisting system; c) drilling mud Circulation system; d) oil rig power generation; e) Controlling system; f) Monitoring.

After determining the operational risks in oil and gas wells, we evaluate the economic feasibility of covering these risks

METHOD OF RESEARCH

Feasibility studies are a controlled process to simultaneously identify the problems and benefits of implementing a project or enter into an investment opportunity and will be done with full description of conditions and estimates the revenues and expenses (cost-benefit analysis). The purpose of feasibility studies is to determine the level of feasibility and applicability of a project and its effectiveness. These studies are known as the first step in the decision-making process of investors or managers.

Therefore, feasibility studies are based on analysis and test that provide necessary information to make a decision to move towards stages of engineering design and implementation of any project or investing. Hence, feasibility studies could be a turning point for the decision-making process in the implementation of a project or investment. This chapter deals with the economic feasibility studies of covering operational risks associated with oil and gas wells and fields. In most of the construction projects, TELOS method is used for feasibility studies which has five common factors that this term "TELOS" is also made up of the first letters of these five factorswhich include: technical, economic, legal, operational; Scheduling.

Two reference indicators are used to evaluate the economic feasibility of covering operational risks associated with oil and gas wells. The first indicator is related to the loss ratioand the second indicator is related to the profitability and profit margin of oil and energy insurance fields that are all carried out by the methods of engineering economics and analysis of various scenarios (DaghighiAsle, 2012).

It should be noted that due to the lack of data in control policies of oil wells, oil and energy insurances have been used that have a high compatibility with our considered insurance both in terms of intensity and probability.

4-1- Loss coefficient of oil and energy insurance

In the past, loss ratio was used to calculate the loss coefficient which included: Compensation during the period divided by the premium received during the same period.

As it's obvious, the numerator is the paid damage during a one-year period and the denominator is the premium issued in the same period. But the main problem is that the majority of paid damages during the considered period are related to policies issued in the past, not policies that are calculated in the denominator. The reason of this is obvious; the process of evaluating the damage in some fields such as third party insurance sometimes takes a few months or a few years to be completed. Thus, compared to the previous period, if the portfolios of a company decline over a period of time, then its loss ratio will increase because damages have entered the company with delay but the premium doesn't include that delay. And conversely, if a company faces a sales growth, if the growth of damage is lower than the premium growth, the company may experience a reduction in the loss ratio.

To correct the mentioned problem, a new damage coefficient can be used. This new coefficient can be calculated in two ways.

The first method: After a certain period of time, losses related to policies issued in a given year, for instance, policies of 2015 were examined by this method and the damage coefficient was calculated for them. Although this is an accurate method but requires a longer time because all the damages should be reported and assessed and usually, duo to the closing accounts at the end of the fiscal year it is impossible to calculate it quickly.

The second method: using the following formulas:

$$Dc = \frac{Dt}{Pt}$$

$$Dt = D_{period} - DD_{beginning} + DD_{end}$$

$$Pt = P_{period} + PD_{beginning} - PD_{end}$$

Loss coefficient = Actual damage during the period/ Earned premium during the period

In which:

Dc is equal to the loss coefficient;

Dt is equal to the actual damage during the period;

Pt is equal to the earned premium during the period;

$D_{period}$is equal to the compensation during the period;

$DD_{beginning}$ is equal to the deferred damages at the beginning of the period;

DD_{end} is equal tothe deferred damages at the end of the period;

P_{period} is equal to the premiums issued during the period;

$PD_{beginning}$ is equal to the unearned premium at the beginning of the period;

PD_{end} is equal to the unearned premium at the end of the period.

In other words, the actual damage is the compensation over the period minus deferred damages at the beginning of the period plus the deferred damages at the end of the period and the earned premium is equal to premiums issued during the period plus the unearned premiumat the beginning of the period minus unearned premiumat the end of the period.

Adding reserves to the numerator and the denominator of the fraction cause the indicator of damage ratio to be adjusted due to the growth or increase in the portfolio. So that the premium, policies that have been received in the past but have not yet expired will be added to the issued premium and naturally the received premium related to future periods will be subtracted from that. In other words, in this mode, the denominator indicates the amount of premium that the company holds to respond to their losses during that period. Also, such an adjustment occurs in the numerator. This means that the compensation over the period that is related to the past policies will be subtracted from the compensationover the period and the actual but not paid losses related to the current policies are added to it.

4. 2. The profit margin of Petroleum and Energy insurance

Using the ratios related to the profit margin is one of the most important financial instruments used by organizations and commercial companies to become familiar with their commercial and financial situation.

To put it simply, profit margin measures a ratio or a percentage of the company's profit in exchange of selling it in pure and impure form (before and after taxes) and finally presents some numbers to the stakeholders which ultimately provides the information necessary for evaluation and decision-making.

In the insurance industry, there is an almost inverse relationship between operational and non-operational profit margin with the damage ratio and damage coefficient. This means that if the damage ratio or damage coefficient increases in the insurance company, we should not expect an increase in profit margin calculations particularlyoperating profit margin.

Profit margin can be used as a tool for understanding the operating behavior of an insurance company and according to the information available in financial reports; it can be used as a tool to evaluate the financial indicators in insurance companies. Changes in the company's profit margin have been interpreted scientifically and traditionally as the changes in the operating ability and reduction in the ability to generate profits.

But the fact that how should we really determine the appropriate ratios to consider the level of these abilities in insurance companies is the topic of researches and different theories and even standardization patterns in the insurance industry, especially scientific and academic circles.

For example, in a research study, the appropriate ratio of profit margin in insurance companies is about 3 to 8 percent as the two lower and upper limits and states that the average profit margin is 5 to 4 %. In this section, profitability and profit margin index have been explained in the field of oil and energy insurance by using the engineering economics method and designing various scenarios.

The amount of profit here is:

The difference between the insurance industry revenues from insurance policies of oil, gas and petrochemical industries and costs related to these fields with regard to costs such as administrative and general expenses, commission[1] and compensation.

[1]**The ratio of administrative, general costs**: is that part of the issued premiums to pay employees and supply other general expenses of the company.

The ratio of commission's cost: is that part of the issued premiums to pay the sales network (agents and insurance brokers) and factors related to the premium manufacturing. This ratio is obtained by dividing the total cost of commission and the commission of benefits on the premiums issued multiplied by 100. **The commission;** is the percentage of premiums that is paid for selling insurance by insurance companies to the agent or insurance broker.

$$\pi_i = P_i - L_i - Ca_i i = 1.2.3.000.13$$

π_i : The amount of profit in ith year

P_i : The earned premium in ith year

L_i : The actual loss in ith year

Ca_i : Administrative and general expenses and commission in ith year

Profit margin is equal to the difference between revenues and expenses divided by revenues.

$$\pi_t = \sum_{i=1}^{13} \frac{\pi_i}{13}$$

$$\pi_{ri} = \frac{\pi_i}{P_i}$$

$$\pi_{rt} = \sum_{i=1}^{13} \frac{\pi_{ri}}{13}$$

π_t : The average profit in 13 years

π_{ri} : The profit margin in ith year

π_{rt} : The average profit margin in 13 years

DATA AND RESULTS

According to the fact that statistics related to damages and insurance policies related to oil and gas wells are not published separately in the country and all these risks and insurance policies are released under the title of oil and energy insurance, therefore, the data used in this study is related to the oil and energy sector. It should be noted that risks associated with the oil and energy sector have been used as the best possible PROXY because of the correlation and many similarities in the intensity of their occurrence with the risks associated with oil and gas wells.

According to the above formula and based on the statistics published by the Central Insurance, the total loss coefficient of the insurance industry was 84.58 percent in 2014 which has fallen by 4.7 percent compared to the previous year and has reached a more favorable situation (Insurance Statistical Yearbook - 2014). The average of the total damage coefficient in the insurance industry was 78.64 percent in the last 10 years which is relatively high and decreases the profit margin of insurance industry.

In the following table, the profit margin of insurance industry has been shown for governmental and non-governmental companies separately over the last decade, 2005-2014.

Table 1. The profit margin of insurance industry for governmental and non-governmental companies separately over the last decade

Year	Governmental (%)	Non-governmental (%)	Total (%)
2005	82.45	52.34	78.51
2006	78.37	57.2	75.03
2007	75.29	67.44	72.09
2008	76.87	67.55	74.65
2009	78.45	70.25	74.8
2010	86.29	72.41	78.56
2011	80.82	71.41	76.27
2012	85.61	87.39	82.62
2013	96.15	87.46	89.28
2014	91.2	80.03	84.58
Total average	83.15	71.35	78.64

Source: Insurance Statistical Yearbook 2014

As can be seen, the damage coefficient of governmental companies is far higher than the damage coefficient of private companies which shows the efficiency and more accurate calculation of premiums in private companies.

For more accurate calculation and making decisions on the field of oil and energy insurance, in addition to the investigation of damage coefficient of insurance industry, the damage coefficient of insurance fields of oil and gas wells should also be examined. It should be noted that since in the published statistics, thefields of oil and gas well insurance are not provided separately, so the best alternative and proxy for investigating this kind of insurance is the field of oil and energy insurance.

The following table shows the damage coefficient of oil and energy insurance separately based on the earned premium and actual damage during years 2005-2014:

Table 2.Damage coefficient of oil and energy insurance over the past ten years (billion Rials)

Year	Earned Premium	The growth rate of earned premium	Actual damage	The growth rate of actual damage	Loss coefficient (%)
2005	431.8	-	123.1	-	28.5
2006	615.8	42.6%	311.6	153%	50.6
2007	890.2	44.6%	233.2	-25%	26.2
2008	876.6	-1.5%	101.6	-56%	11.6
2009	996.1	13.6%	198.6	95%	19.9
2010	902.6	-9.4%	218	10%	24.2
2011	1075.1	19.1%	152	-30%	14.1
2012	2028.1	88.6%	276.1	82%	13.6
2013	2047.9	1.0%	675.2	145%	33
2014	3749.4	83.1%	1036.6	54%	27.6
Average	1361.36	31.3%	332.6	47.4%	24.93

Source: Insurance Statistical Yearbook 2014

As can be seen in the table above, the damage coefficient of oil and energy insurance is under 30 percent in all the years except in 2006 and the average of the past 10 years is about 25%. Given that the total damage coefficient of the insurance industry is 78%, thus the damage coefficient in oil and energy insurance is far lower than the entire insurance industry and this can be an indicator for showing the profitability of this type of insurance. It is observed that the damage coefficient of the fields of oil and energy insurance was lower than the averageof the total damage coefficient of insurance industry (78 percent) in all the years and there is a huge discrepancy between them. Therefore, it can be figuratively[1] concluded that the profitability of this type of insurance has been higher than the total insurance industry during all these years. The profit margin of oil and energy insurance has been explained to examine the profitability of this type of insurance more accurately.

As noted in the research method it is necessary to examine the revenues and expenses of these fields of insurance to evaluate their profitability. The following table shows the premium status and compensation and administrative, general and commission costs in the field of oil and energy insurance during 2002 to 2014:

[1] This indicator cannot be considered as an accurate source for comparing the profitability because the administrative, general and commission costs are also involved in the calculation of the profit that this indicator is indifferent towards them. But this comparison can be made approximately.

Table 3. Premium status and compensation and administrative, general and commission costs in the profit margin of oil and energy insurance during 2002 to 2014 (billion rials)

year	Earned premium	Actual damage	The proportion of administrative, general and commission costs (percent)	Administrative, general and commission costs	The amount of profit	Profit margin
2002	165.6	3	16	26.5	136.1	82.2%
2003	571.6	25.9	16	91.5	454.2	79.5%
2004	567.4	484.6	16	90.8	-8.0	-1.4%
2005	431.8	123.1	15	64.8	244.0	56.5%
2006	615.8	311.6	14	86.2	218.0	35.4%
2007	890.2	233.2	14	124.6	532.4	59.8%
2008	876.6	101.6	15	131.5	643.5	73.4%
2009	996.1	198.6	18	179.3	618.2	62.1%
2010	902.6	218.0	15	135.4	549.2	60.8%
2011	1075.1	152.0	14	150.5	772.6	71.9%
2012	2028.1	276.1	12	243.4	1508.7	74.4%
2013	2047.9	675.2	14	286.7	1086.0	53.0%
2014	3749.4	1036.6	14	524.9	2187.9	58.4%
average of profit margin over 13-year						58.9%

Source: Insurance Statistical Yearbook 2014

As can be seen in the above table, the profit margin of oil and energy insurance is positive and more than 50 percent in all these years (except 2004) and the average profit margin of this type of insurance was about 59 percent in the last 13 years that is a very high proportion and is a reasonable margin for the investors in this sector. Usually, in developed countries, profit margin of insurance is economically feasible around 4-5% and in Iran due to high inflation the industry profit margin is compared with the Bank interest rate. This means that if the profit margin of an activity is higher than the Bank interest rate for one-year deposits then it is economically feasible.

In the following, to prove the sustainability of the profit margin in this type of insurance activities, with a 10, 20 and 30 percent reduction in premiums and also 25, 50 and 100 percent increase in compensations, various scenarios are provided in the table below:

Table 4.Scenario building to demonstrate the sustainability of the profit margin

Scenario	Premium changes	Changes in losses

1	No change in Premium	No change in losses
2	No change in Premium	25 percent increase in losses
3	No change in Premium	50 percent increase in losses
4	No change in Premium	100 percent increase in losses
5	10% reduction in Premium	No change in losses
6	10% reduction in Premium	25 percent increase in losses
7	10% reduction in Premium	50 percent increase in losses
8	10% reduction in Premium	100 percent increase in losses
9	20% reduction in Premium	No change in losses
10	20% reduction in Premium	25 percent increase in losses
11	20% reduction in Premium	50 percent increase in losses
12	20% reduction in Premium	100 percent increase in losses
13	30% reduction in Premium	No change in losses
14	30% reduction in Premium	25 percent increase in losses
15	30% reduction in Premium	50 percent increase in losses
16	30% reduction in Premium	100 percent increase in losses

Source: The assumptions of the researcher

The table below shows the average profit margin of oil and energy insurance in form of the mentioned scenarios over the last 13 years:

Table 5.Averageprofit margin of oil and energy insurance over the past 13 years in form of 16 scenarios

scenario	Premium changes	Changes in losses	profit margin
1	No change in Premium	No change in losses	58.8%
2	No change in Premium	25 percent increase in losses	52.2%
3	No change in Premium	50 percent increase in losses	45.6%
4	No change in Premium	100 percent increase in losses	32.5%
5	10% reduction in Premium	No change in losses	55.8%
6	10% reduction in Premium	25 percent increase in losses	48.6%
7	10% reduction in Premium	50 percent increase in losses	41.3%
8	10% reduction in Premium	100 percent increase in losses	26.7%
9	20% reduction in Premium	No change in losses	52.2%
10	20% reduction in Premium	25 percent increase in losses	44.0%
11	20% reduction in Premium	50 percent increase in losses	35.8%
12	20% reduction in Premium	100 percent increase in losses	19.4%
13	30% reduction in Premium	No change in losses	47.5%
14	30% reduction in Premium	25 percent increase in losses	38.1%
15	30% reduction in Premium	50 percent increase in losses	28.8%
16	30% reduction in Premium	100 percent increase in losses	10.0%
average of profit margin over 13-year			39.8%

Source: Calculations of the researcher

Obviously, the most amount of profit margin is related to the current situation that shows the rate of 58% which reflects a very good profit margin. Among the 16 calculated scenarios, only the last scenario which is the worst-case scenario in designed scenarios, which means a 30%reduction in premium and a 100 percent increase in compensation, shows a 10 percent profit margin that is lower than the minimum one-year deposit interest of banks. But since, on one hand, this scenario is the worst-case scenario designed and on the other hand, profit margin is not zero or negative so it is acceptable. The profit margin in other scenarios is higher than the minimum one-year deposit interest of banks that is 15 percent which shows the high profits of this type of insurance.

Thus, according to the low damage coefficient of this type of insurance and their relatively high profit margin, their profitability is proven economically and investment and providing insurance coverage has adequate warrantability for this type of risks.

SUMMARY AND CONCLUSIONS

Oil and gas insurance are among the lucrative and widely used insurance in developed and oil-rich countries in the world. While this area has been neglected in Iran and according to the Statistical Yearbook of the insurance industry in 2014 the share of energy insurance in the insurance portfolio of the country is only 1.82 percent.

In this study, to evaluate the economic feasibility of the covering of operational risks related to the oil and gas fields and wells two reference indexes has been used. The first indicator is related to the loss coefficient and the second one is related to the Profit margin of fields of oil and energy insurance that was investigated using engineering economics and analysis of various scenarios.

The applied calculations revealed that the damage coefficient of oil and energy insurance are all below 30 percent, except in 2006 and the average of the past 10 years is about 25%. Given that the total loss coefficient of the insurance industry is 78%, therefore, the damage coefficient in Oil and energy insurance is far lower than the total insurance industry and this can be an indicator for the profitability of these types of insurance.

Also, the profit margin in the fields of oil and energy insurance is positive and above 50% in all years (except 2004) and the average profit margin of this field is about 59% over the past 13 years which is a very high and is considered as a safe margin for investors in this sector

In addition, to prove the sustainability of the profit margin in these types of insurance activities the profit margin of this field of insurance has been investigated by designing various scenarios.

Among the 16 calculated scenarios, only the last scenario which is the worst-case scenario in designed scenarios, which means a 30% reduction in premium and a 100 percent increase in compensation, shows a 10 percent profit margin that is lower than the minimum one-year deposit interest of banks. But since, on one hand, this scenario is the worst-case scenario designed and on the other hand, profit margin is not zero or negative so it is acceptable. The profit margin in other scenarios is higher than the minimum one-year deposit interest of banks that is 15 percent which show the high profits of this type of insurance.

Thus, according to the low damage coefficient of this type of insurance and their relatively high profit margin, their profitability is proven economically and investment and providing insurance coverage has adequate warrantability for this type of risks.

REFERENCES

1. Bahmani, Haidar, (2012) "Principles of engineering and blowout control operations and Containment of oil and gas wells" Tehran: Publication of Science and Technology Park, Tehran University
2. BP, (2010). Deepwater Horizon accident investigation report, Bp express
3. Collin, Leach. (2013) "deep water well control", Argonauta Drilling Services L.L.S, 2-3
4. DaghighiAsli, AR, M, NouroziShima, (2012) economic feasibility of establishing specialized company of oil, gas and petrochemical insurance in Iran, Journal of Insurance, twenty-seventh year, No. 2, pp. 158-135.
5. Danaher, B., (1994). Risk management an oil and gas industry perspective. Represented in Health & Safety Conference.
6. Derakhshan M., (2010) Development of insurance coverage in oil and gas and petrochemical industries, Journal of energy range, fourth year, No. 45
7. Dezhipeng David, (1993), Insurance and Legal Issues in The Oil Industry, Kluwer Academic Publishers Group.
8. Doukas, H., Flamos A. and Psarra, J. (2011). Risks on the security of oil and gas supply. Energy Sources, vol.6, no. 4.
9. Ebrahimi, Seyednasrolah (2009), the need for mutual interaction of Insurers and policyholders in implementing upstream projects of oil and gas industry, 26 and 27 of September 2009, Tehran, Second Conference of Oil and Gas and Petrochemical insurance, Tehran
10. Fossli, B. and Sangesland, S. (2004): "Managed Pressure Drilling for Subsea Applications; Well Control Challenges in Deep Waters," Proc., 14th Deep Offshore Technical Conference, New Orleans.
11. Grace, (2003). Blowout and well control handbook. Houston: Gulf Professional Publishing.
12. Greene, Mark R.; Trieshman, James (1988). Risk and Insurance,9th ed, Cincinnati. Ohio: South- western Pub. Co.
13. HeidarBahmani, Khalil Shahbazi, M, Makvandi, Mustafa MoradiNejad (2011), blowout control operations and Containment of Naftshahr 24 oil well, The scientific journal of exploration and production of oil and gas, No. 80, p. 35-41
14. Imran, Muhammad. (2013), A Critical Review of an Improved Well Control Procedure for The Prevention of Blowouts, Dalhousie University, Faculty of Engineering, Halifax, Nova Scotia, for the degree of MEng in Petroleum Engineering
15. IXTOC-1 Mexico, (1979). The IXTOC-I Well Blowout: The Gulf of Mexico.
16. King, Rawle O. (2010), Deepwater horizon oil spill disaster: risks, recovery, and insurance implications, US congressional research service.
17. NoussiaKyriaki (2012), Environmental Pollution Liability and Insurance Law Ramifications in Light of the Deepwater Horizon Oil Spill, Springer-Verlag Berlin Heidelberg.
18. Panahi Azad Maryam et al (2012), investigating the role and structure of insurance in risk management of oil, gas and petrochemical industries, presented in the second Conference of Planning and Environmental Management
19. Patricia Birnie, Alan Boyle, Catherine Redgwell, (2009), International law and the environment, Oxford; New York: Oxford University Press, 3rd ed.
20. Saki ZadehMojtaba, (2013), the need for a more effective interaction of insurance with oil and gas industry the scientific journal of exploration and production of oil and gas, Issue 104
21. Seog, S. Hun, (2010) The Economics of risk and insurance, wiley-blackwell.
22. Shami M, Khanifar Hussein, Hamid Reza Hassanzadeh, (2014) investigating the barriers of Energy Insurance growth in the insurance industry of the country and suggesting suitable strategies, management of organizational culture, Volume 12, Number 4, Ss696-681.
23. Sharp, D. W. (2010), offshore oil and gas insurance, London:withererby.
24. Skalle, P. and Podio, A.L. (1998). Trends extracted from 1,200 gulf coast blowouts during 1960-1996. World Oil; 219: 67–72.
25. SPE 149555, (2012). Drilling Fluid: State of The Art and Future Trend.
26. Statistical Yearbook of Insurance Industry (2014), Planning Management, Department of statistical analysis, the Central Insurance of Iran, Tehran.
27. Stevens, Paul (2011), "Energy Economics", translated by Taherifard, Ali et al., University of Imam Sadeq (AS), Tehran.
28. Zhaoguang Yuan, YahyaHashemian, Daniel Morrell, (2015), Ultra-deepwater blowout well control analysis under worst case blowout scenario, Journal of Natural Gas Science and Engineering.